B. Sc. Part – I Semester – I
DSC-II
(ELEMENTARY PROBABILITY THEORY)
Theory: 30 hrs. Marks -50 (Credits: 02)

Course Outcomes: Students will be able to;

i. Distinguish between random and non-random experiments
ii. Use the basic probability rules, including additive and multiplicative laws
iii. Understand concept of conditional probability and independence of events.
iv. Understand concept of univariate random variable and its probability distributions

CONTENTS:

Unit - 1 **(15 hrs.)**

1.1 Sample space: Concepts of experiments and random experiments. Definitions: Sample space, Discrete sample space (finite and countably infinite).

- **Events:** Elementary event, Compound event. Algebra of events (Union, Intersection, Complementation). Definitions of mutually exclusive events, Exhaustive events, Impossible events, Certain event.
- **Power set |P(Ω)** (sample space consisting at most 3 sample points). Symbolic representation of given events and description of events in symbolic form. Illustrative examples.

1.2 Probability: Equally likely outcomes (events), a priori (classical) definition of probability of an event. Equi-probable sample space, simple examples of computation of probability of the events based on permutations and combinations. Definition of probability in terms of odd ratio with illustrative examples.

- **Axiomatic definition of probability and proof of the results**: i) $P(\Phi) = 0$, ii) $P(A^c) = 1-P(A)$, iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ (with proof) and its generalization (Statement only), iv) If $P(A \subset B)$, $P(A) \leq P(B)$ v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$.
- **Conditional Probability:** Definition of conditional probability of an event. Multiplication theorem for two events. Examples on conditional probability.

Unit - 2 **(15 hrs.)**

2.1 Independence of events: Concept of independence of two events. Proof of the result that if A and B are independent then, i) A and B^c are independent, ii) A^c and B are independent, iii) A^c and B^c are independent. Pairwise and Mutual independence for three events. Elementary examples.

- **Baye's theorem**: Partition of sample space, Idea of posterior probability, statement and proof of Baye's theorem, illustrative examples on Baye's theorem.
- **Univariate Probability Distributions (finite sample space):** Definition of discrete random variable. Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.) of a discrete random variable, Properties of c.d.f. (statements only). Probability distribution of function of random variable.
- **Median and mode**: Median and mode of a univariate discrete probability distribution. Examples.

2.2 Mathematical expectation (Univariate random variable): Definition of expectation of a random variable. Expectation of a function of a random variable, Results on expectation of a functions of a random variable: i) $E(c) = c$, where c is a constant, ii) $E(aX + b) = aE(X) + b$, where a and b are constants,

- **Mean and variance:** Definitions of mean and variance of univariate distribution, $V(aX + b) = a^2 V(X)$
- **Raw and central moments:** Definition of raw and central moments.
- **Probability generating function (p.g.f.):** Definition of probability generating function (p.g.f.) of a random variable, Mean and variance by using p.g.f., Effect of change of origin and scale on p.g.f.

Books Recommended:

1. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg, R.V. and Craig R.G.(1989).Introduction to Mathematical Statistics, Ed. MacMillan Publishing Co., New York.
5. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co., London.
6. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, Mc Graw Hill Book Company.
7. Rao, VLS Prakash (2008). First Course in Probability and Statistics, New Age International Publishers, New Delhi.
8. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.
9. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John wiley & Sons (Asia).